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Application of M-test for evaluation of the physical condition of boxers: Comparison of the results obtained for boxers with and without a history of low-back pain

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Abstract

[AIM] The purpose of this study is to investigate the differences in the M-test scores, self-awareness scores, and the general physical condition of boxers with or without a history of low-back pain (LBP).

[Design] Cross-sectional, case-control study.

[Setting] The subjects of our study were 20 university boxers. The subjects were divided into 2 groups on the basis of LBP history: group 1 included subjects with a history of LBP, and group 2 included subjects without a history of LBP. The study was performed during a summer training camp from September 9, 2005 to September 15, 2005.

[Main outcome measure] We obtained the M-test scores for trunk and leg movements in both groups of subjects. The self-awareness assessment comprised 9 items, including 4 items related to sports training and 5 items related to the subjects' perception of their physical condition.

[Results] The M-test scores of subjects with a history of LBP were higher than those of subjects with no history of LBP, thereby reflecting the lower flexibilities of the hip joint and trunk regions of the subjects with LBP. The baseline physical-condition scores of the 2 groups were significantly different. We also observed significant intergroup differences in day-6 scores for self-assessment of physical condition upon rising in the morning.

[Conclusion] Application of M-test in combination with subjective evaluation of the subjects may prove useful for athletes and help prevent external injuries.

Key words: *M-test, Condition, Boxing, Low-back Pain*

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Ⅰ. Introduction

In an athlete, the lumbar vertebrae usually perform demanding and extreme tasks[1]. The reported incidence rates of low-back pain (LBP) in athletes range from 1% to more than 30% and vary with the type of sport, gender of the athlete, and the training intensity, frequency, and technique[2,3]. However, in many cases, the specific source of the pain cannot be conclusively identified, thereby complicating its diagnosis and treatment[4]. LBP in athletes is often considered to be a result of training fatigue. Such LBP is called nonspecific LBP, and is considered to be primarily muscle or soft-tissue pain[5]. Measurement of heart rate, blood pressure, body temperature, and homeostasis; numerical evaluation of self-awareness; information about the training regimen; profile of mood states; and other such parameters can be used to diagnose training fatigue as the cause of LBP in athletes[6]. There is currently no direct method of measuring joint fatigue directly, which might be very useful for athletes.

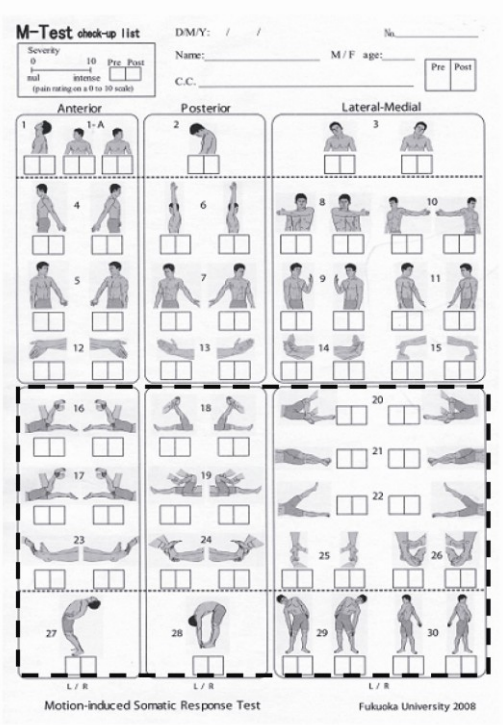

Figure 1 M-test checkup list

: A total of 15 items were examined in the M-test (4 waist movements and 11 leg movements)

The Meridian test (M-test), which is also referred to as the motion-induced somatic response test is a diagnostic method developed by Dr Y Mukaino, Professor of Sports Science at Fukuoka University in Japan (Figure 1). The M-test is an easy and quick method to determine the precise meridian that requires treatment. The test is based on a fundamental concept of oriental medicine and involves collection of information about the meridians, or channels of energy, of the body. In this assessment, a series of 30 simple tests involving the whole body are performed to identify the affected meridian responsible for the restricted movement[7]. Thus, each joint movement that induces or aggravates pain is identified; for example, pain and weakness induced by flexion of the shoulder joint are considered the results of stretching the heart meridian (HT) and small intestine meridian (SI). Therefore, treatment can then be directed at the points along the HT or SI[7]. Currently, the M-test is applied in acupuncture and moxibustion therapy for athletes[8] and in guided stretching to prevent injury or facilitate recovery from fatigue. Honda[13] suggested the potential applicability of the M-test for evaluation of athletes. In Japan, acupuncture is often used to treat athletes' injuries and to facilitate early recovery from fatigue. The curative effects of acupuncture for the chronic disability resulting from sports activities and the ameliorative effects of acupuncture for delayed-onset muscle soreness and muscle fatigue have been examined in athletes[14].

The purpose of our study was to investigate the differences in the M-test scores, self-awareness scores, and the general physical condition of athletes with or without a history of LBP.

Ⅱ. Materials and Methods

Subjects

The subjects of our study were 20 university boxers (20 men; age, 20.3 ± 1.0 years; height, 166.9 ± 5.7 cm; weight, 57.9 ± 6.3 kg). All our subjects were actively training and had the same training regimen. The subjects were divided into 2 groups on the basis of their LBP history: group 1 comprised subjects with a history of LBP (n = 12; age, 20.1 ± 1.1 years; height, 167.4 ± 5.9 cm; weight, 57.5 ± 6.4 kg), and group 2 comprised subjects without a history of LBP (n = 8; age, 20.5 ± 0.8

years; height, 166.2 ± 5.7 cm; weight, 58.6 ± 6.4 kg). Examinations performed before the study revealed that none of the subjects had LBP at the beginning of the study. The study was approved by the research ethics committee of University of Tsukuba. Each subject provided informed consent before participating in the study.

Study period and protocol

The study was performed during a summer training camp conducted between September 9, 2005 and September 15, 2005. M-test scores obtained before the first practice session on the first day of the training camp (Day 1) were considered as the baseline scores. The baselines scores of the 2 groups were similar. During the study period, the M-test was performed after practice sessions in the morning and the afternoon (2 practice sessions daily). We also evaluated the subjects' perceived pain after each afternoon practice session.

The M-test involved various joint movements that were scored as +1 if they caused pain, tension, restricted movement, or weakness. The sum of the scores was calculated.

Examination

M-test: We calculated the M-test scores for trunk and leg movements; a total of 15 items (4 trunk movements and 11 leg movements) were examined in this assessment. For each M-test movement, the scores for the right

Table 1 The test item (No.) that showed significant intergroup difference in the positive movement M-test score

Day 2 morning				Day 2 night			
No.	Group 1	Group 2	p	No.	Group 1	Group 2	p
17	6	0	0.03§	20	6	0	0.03§
27	7	1	0.04§	30	12	3	0.046§
28	7	1	0.04§				
30	10	0	0.002§				

Day 3 morning			
No.	Group 1	Group 2	p
20	13	2	0.008§
30	12	3	0.045§

Day 5 morning				Day 5 night			
No.	Group 1	Group 2	p	No.	Group 1	Group 2	p
20	12	2	0.014§	21	10	2	0.049§
22	17	5	0.014§	22	16	4	0.01§
29	18	5	0.006§	29	17	6	0.037§

Day 6 morning				Day 6 night			
No.	Group 1	Group 2	p	No.	Group 1	Group 2	p
20	13	1	0.001§	20	10	1	0.014§
				21	10	2	0.049§
				22	16	2	0.001§
				29	14	4	0.038§

Day 7 morning			
No.	Group 1	Group 2	p
20	11	1	0.007§
21	10	2	0.049§
22	16	4	0.01§

Group 1: Subjects with a history of low-back pain § : $p < 0.05$
Group 2: Subjects without a history of low-back pain
*, No.: item number of the M-test. Group 1 and Group 2: the number of subjects with positive M-test score for each item

and left sides were added and considered as 1 score (Figure 1).

Self-awareness assessment: The self-awareness assessment comprised 9 items. These included 4 items related to sports training: (1) training intensity, the degree of strength of movement felt during training; (2) training effort, the extent of effort exerted during training; (3) training motivation, motivation for training during a day; and (4) physical condition, state of body activity during training. The other 5 items were related to the subjects' perception of their physical condition: (1) physical condition upon rising in the morning, perceived physical condition when the subject woke up in the morning; (2) general physical condition, perceived general condition during a day; (3) degree of recovery from fatigue upon rising in the morning, perceived recovery from physical fatigue when the subject woke up in the morning; (4) level of injury or pain, the level of injury or pain felt by the subject during training; and (5) appetite, level of the subjects' appetite through a day. The subjects were asked to record all items and rate each item on a scale of 1 (very bad) to 5 (very good)[9]; then, the obtained scores of both groups were compared.

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences (SPSS) 2 (SPSS Inc, Tokyo). The scores of the self-awareness assessment were compared by performing Mann-Whitney U test. Chi-square test was performed to compare the M-test scores of the 2 groups. P values less than 0.05 were considered statistically significant.

Ⅲ. Results

M-test

The M-test items that showed significant intergroup differences are presented in Table 1. We did not observe any significant intergroup differences in the baseline scores for the items of the M-test (p-value, 0.13-1). However, during the evaluation of movements of the hip joint and trunk, we observed significant intergroup differences in the scores for the following items (the figures in the parenthesis represent the intergroup differences):

1) Day 2 morning: knee flexion (17); trunk extension (27); trunk flexion (28); and trunk rotation (30)

Table 2 Self-awareness condition test (sports training items) scores for groups 1 and 2

	Day 1			Day 2			Day 3			Day 4			Day 5			Day 6		
	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p
Training intensity	10.1	11.1	0.7	10.5	10.5	1	10.8	10.1	0.82	10.5	10.4	0.97	10.8	10.1	0.82	9.5	11.9	0.37
Training effort	11.2	9.4	0.51	10.8	10	0.76	11.5	9	0.35	11.7	8.7	0.26	10.5	10.4	0.97	11	9.7	0.62
Training motivation	10.5	10.5	1	9	12.8	0.16	10.6	10.4	0.94	10.2	10.9	0.79	8.8	13	0.12	9.9	11.4	0.59
Physical conditioning	8.3	13.8	0.04§	11.1	9.6	0.59	10.8	10.1	0.82	10.9	9.9	0.7	10.5	10.5	1	10.2	10.9	0.79

Group 1: Subjects with a history of low-back pain
Group 2: Subjects without a history of low-back pain
§ : $p < 0.05$

Table 2 Self-awareness condition test (sports training items) scores for groups 1 and 2

	Day 1			Day 2			Day 3			Day 4			Day 5			Day 6		
	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p	Group 1	Group 2	p
Condition upon rising in the morning	7.2	9.2	0.41	9.4	12.1	0.32	9.8	11.6	0.51	10.4	10.7	0.91	11.7	8.7	0.26	8	14.3	0.02§
General physical condition	10.5	10.5	1	10.7	10.3	0.88	10.7	10.3	0.88	10.1	11.1	0.7	9.8	11.4	0.56	10	11.2	0.67
Degree of recovery from fatigue upon rising in the morning	10.7	10.3	0.88	9.9	11.4	0.59	10.8	10.1	0.82	9.7	11.8	0.44	9.8	11.6	0.49	10.6	10.3	0.91
State of injury or pain	9.9	11.4	0.59	10.3	10.8	0.88	11	9.7	0.62	10.7	10.2	0.85	10.4	10.6	0.94	9.9	11.4	0.56
Ingestion of a meal	11	9.8	0.64	9.1	12.6	0.19	10.6	10.4	0.94	10.5	10.5	1	10.1	11.1	0.73	10.3	10.9	0.82

Group 1: Subjects with a history of low-back pain § :$p<0.05$
Group 2: Subjects without a history of low-back pain

2) Day 2 night: hip flexion, hip abduction and external hip rotation (20); and trunk rotation (30)
3) Day 3 morning: hip flexion, hip abduction and external hip rotation (20); and trunk rotation (30)
4) Day 5 morning: hip flexion, hip abduction and external hip rotation (20); hip abduction (22); and lateral trunk fold (29)
5) Day 5 night: hip adduction (21); hip abduction (22); and lateral trunk fold (29)
6) Day 6 morning: hip flexion, hip abduction and external hip rotation (20)
7) Day 6 night: hip flexion, hip abduction and external hip rotation (20); hip adduction (21); hip abduction (22); and lateral trunk fold (29)
8) Day 7 morning: hip flexion, hip abduction and external hip rotation (20); hip adduction (21); and hip abduction (22).

Self-awareness condition test

Items associated with Sports Training

The test scores for training intensity, effort, motivation, and physical condition of both groups are shown in Table 2. The baseline physical-condition scores of the 2 groups were significantly different, while the baseline scores for the other items did not significantly differ between the 2 groups.

Assessments of Perceived Physical Condition

The test scores for physical condition upon rising in the morning, general physical condition, degree of recovery from fatigue upon rising, level of injury or pain, and appetite are shown in Table 3. We found no significant intergroup differences in the baseline scores of these items. We observed a significant intergroup difference in the day-6 scores for physical condition upon rising in the morning, while there were no significant intergroup differences for the scores of any of the other item.

IV. Discussion

M-test scores

In this study, we examined whether the M-test scores for athletes with a history of LBP differ from those for athletes with no history of LBP. We simultaneously compared the M-test scores and self-awareness scores of the 2 groups. The scores for few items in the self-awareness assessments showed significant intergroup differences. The fact that none of the subjects experienced pain during the study can be attributed to the lack of significant intergroup differences in the self-awareness scores. The results of the M-test revealed that the group-1 subjects, who had a history of LBP, experienced more fatigue during trunk rotation, extension, and flexion after day 2 than the group-2 subjects did. Mellin[10] reported that acute LBP decreases the flexibility of the lumbar spine and hip joints. Mellin[11] also compared the flexibilities of the lumbar spine and hip joints of subjects with and without a history of LBP and reported that in men with a history of LBP, extension, lateral flexion, and total mobility of the lumbar spine; hip flexion; and external rotation of the shoulders were lesser than those in men without a history of LBP. In the same study, the extension and total mobility of the thoracic spine of women with a history of LBP were significantly lower than those of women with no history of LBP, and the extension, external rotation, and total mobility of the hips of women with a history of LBP were lower than those of women with no history of LBP. On the basis of these results, we assumed that the flexibility of the lumbar spine and hip joints may decrease in subjects with a history of LBP. The findings of our study indicate that group-1 subjects experienced pain or a sense of discomfort earlier than the group-2 subjects did. The results of the M-test indicated that the level of weakness in hip abduction, adduction, and external rotation movements in group-1 subjects was greater than that in group-2 subjects. Mellin[12] reported that although hip mobility did not correlate with forward movements of the spine, it correlated with lateral flexion, and rotation. In our study, although the subjects experienced the maximum pain on the night of day 3, we found no intergroup differences in the scores on day 4. On days 5, 6, and 7, however, it is easy to have done neither hip abduction, adduction, nor external rotation to subjects in group 1 compared with subjects in group 2. Furthermore, as mentioned above, in group-1 subjects pain or a sense of discomfort occurred earlier and recovered slower than group-2 subjects did.

Evaluation index for physical condition of an athlete

Training and evaluation of an athlete is based on self-awareness, such as perception, anticipation, perspective, and attitude, rather than objective items[6]. Kono et al.[15] reported that a self-awareness index provides useful information about the condition of an athlete. However,

self evaluation is often inadequate; therefore, the athlete's condition should be evaluated using an objective rating scale. Indices such as heart rate, autonomic nervous system function, and serum chemistry scores are objective parameters that are typically examined to evaluate an athlete's condition. The use of the M-test in conjunction with these parameters may be beneficial in objective evaluation of the athlete's condition.

Characteristics of the subjects of the present study

In general, we obtained low M-test scores for the posterior parts of the subjects' bodies. Boxing involves repetitive punching, which can easily induce fatigue in the posterior parts of the body, including the latissimus dorsi and erector muscles of the spine[16]. A previous study reported that boxing coaches and trainers would like to have an objective method to determine the extent of pain that is not caused by injuries associated with training and practice[17]. The M-test may help prevent these injuries in boxers by making them aware of the disadvantages of certain movements.

Limitations

In the M-test, the subjects themselves decide which movements cannot be performed easily; the subjects' judgment may be influenced by subjective criteria such as physical exhaustion. Izumi et al. had reported large intraobserver variability during M-test[18]. In addition, the time required to perform M-test was also problematic. Initially, we could not easily distinguish between the positive and negative scores of the subjects, and we required approximately 10 min, and the athlete can perform the test with minimal energy expenditure in the sports field itself. The testing methodology of the M-test is novel but incomplete, and further research is required to develop the testing methodology.

Ⅴ. Conclusion

In this study, we evaluated the physical condition of boxers with and without a history of LBP during a sports training camp by performing M-test. The training regimen involved high levels of activity, and our results showed that the M-test scores of subjects with a history of LBP were higher than those of subjects with no history of LBP.

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